
SECTION A

USER SERVICE REQUIREMENTS (Excerpts)

USER SERVICE REQUIREMENTS

These user service requirements outline the service elements that lead to development of systems architecture, technology needs. The user services that were recommended for further study in the User Service Plan were used to select the needed User Service Requirements. These user service requirements were identified by user service from USDOT document "IVHS" user service requirements, 13 October 1993. The outline of the user service requirements are as follows.

1.0 Pre-Trip Planning

IVHS shall provide a Pre-Trip Planning (PTP) capability. Pre-Trip Planning assists travelers in making mode choice, travel time estimates, and route decisions prior to trip departure. It consists of four major functions: (1) Available Services Information; (2) Current Situation Information; (3) Trip Planning Service; and (4) User Access. Information is integrated from various transportation modes and presented to the user for decision making.

1.1 Available Services Information

PTP shall provide travelers with information on those travel services available for their use.

1.1.1 Timely Information

PTP shall provide users available services information that is timely.

1.1.1.1 Transit Routes

PTP shall provide users the latest available information on transit routes.

1.1.1.2 Schedules

PTP shall provide users the latest available information on transit schedules.

1.1.1.3 Schedules Adherence

PTP shall provide users real time schedule adherence information.

1.1.1.4 Transfers

PTP shall provide users the latest available information on transit transfer options.

1.1.1.5 Fares

PTP shall provide users the latest available information on transit fares.

1.1.1.6 Ridematching Services

PTP shall provide users information on accessing ridematching services.

1.1.1.7 Traffic and Highway Conditions

PTP shall provide users the latest available information on traffic and highway conditions.

1.2 Current Condition Information

PTP shall provide the capability for users to access information on the current condition of transportation systems.

1.2.1 Real time Information

PTP transportation services current situation information shall be provided in real-time.

1.2.1.1 Incidents

Real-time information provided by PTP shall include the current condition of any incidents.

1.2.1.2 Accidents

Real-time information provided by PTP shall include the current status of any accidents or incidents.

1.2.1.3 Road Construction

Real-time information provided by PTP shall include the current condition of any road construction.

1.2.1.4 Alternate Routes

Real-time information provided by PTP shall include the current speeds on specific routes.

1.2.1.5 Traffic Speeds On Specific Routes

Real-time information provided by PTP shall include the current speeds on specific routes.

1.2.1.6 Parking Conditions

Real-time information provided by PTP shall include current parking conditions in key areas.

1.2.1.7 Event Schedules

Real-time information provided by PTP shall include schedules for any current or soon to start events.

1.2.1.8 Weather Information

Real-time information provided by PTP shall include weather situation.

1.3 Trip Planning Service

PTP shall include a trip planning service.

1.3.1 Trip Planning Service

PTP trip planning service shall provide the users with information needed for planning an upcoming trip.

1.3.1.1 Calculated Itinerary

Based on user specified parameters PTP shall provide users with a calculated itinerary,

1.3.1.2 Mode Choices

Based on user specified parameters PTP shall provide users with transportation mode choices

1.3.1.3 Real-Time Travel Conditions

Based on user specified parameters PTP shall provide users with real-time travel conditions for time of inquiry and estimated conditions for estimated time of travel.

1.3.1.4 Alternate Itineraries

Based on user specified parameters PTP shall provide users with one or more alternate itineraries in addition to the primary calculated itinerary.

1.3.2 User Specified Parameters

PTP shall provide the capability for users to specify those transportation parameters that are unique to their individual needs.

1.3.2.1 Desired Destination

PTP shall provide the capability for users to specify a desired destination.

1.3.2.2 Planned Departure Location

PTP shall provide the capability for users to specify a planned departure location.

1.3.2.3 Departure Time

PTP shall provide the capability for users to specify their desired departure time.

1.3.2.4 Arrival Time

PTP shall provide the capability for users to specify their desired arrival time.

1.3.2.5 Total Travel Time

PTP shall provide the capability for users to specify their maximum acceptable travel time.

1.3.2.6 Maximum Number of Mode Changes

PTP shall provide the capability for users to specify their maximum acceptable number of mode changes.

1.3.2.7 Maximum Number of Transfers

PTP shall provide the capability for users to specify their maximum number of transfers.

1.3.2.8 Preferred Routes (s)

PTP shall provide the capability for users to specify their preferred route(s) or segment of route(s).

1.3.2.9 Preferred Mode(s)

PTP shall provide the capability for users to specify their preferred transportation mode(s).

1.3.2.10 Weather Conditions

PTP shall provide the capability for users to specify their preferred weather conditions.

1.3.3 Additional Trip-Planning Factors

In addition to the user specified parameters, PTP shall use additional factors when planning trips.

1.3.3.1 Current Travel Conditions

PTP shall consider current travel conditions when calculating a trip itinerary.

1.3.3.2 Predicted Travel Conditions

PTP shall consider predicted travel conditions when calculating a trip itinerary.

1.4 User Access

1.4.1 Traveler Access Location

PTP shall provide the capability for users to access the Pre-Trip Planning function from multiple distributed locations.

1.4.1.1 At Home

PTP shall provide the capability for users to access the system from their homes.

1.4.1.2 At Work

PTP shall provide the capability for users to access the system from their place of work.

1.4.1.3 Other Major Trip Generators

PTP shall provide the capability for users to access the system from other major trip generation sites.

1.4.1.4 Personal Portable Information Devices

PTP shall provide the capability for users to access the system from personal portable information devices.

1.4.2 User Access Media

PTP shall provide the capability for users to access the Pre-Trip Planning function over multiple types of electronic media.

1.4.2.1 ADA Compliance

Access media shall comply with ADA legislation.

DRIVER INFORMATION

2.0 Enroute Driver Information

IVHS shall include a Driver Information (DI) function. Driver Information provides vehicle drivers with information which will allow alternative routes to be chosen for their destination. Driver Information consists of two major functions: (1) Driver Advisory; and (2) In-Vehicle Signing. The potential decrease in traffic may also provide benefits in highway safety, reduced air pollution, and decreased congestion.

2.1 General Requirements

2.1.1 Help Improve Highway Safety

DI shall be implemented in a manner that helps improve highway safety.

2.1.2 Reduce Environmental Air Pollution

DI shall be implemented in a manner that helps reduce air pollution.

2.1.3 Decrease Congestion

DI shall be implemented in a manner that helps decrease congestion.

2.1.4 Two-Phase Implementation

DI shall be implemented in a manner that permits a two-phase implementation.

2.1.4.1 Short Term

The DI two-phase implementation shall include a short term capability to address those features that can be implemented in the present time frame.

2.1.4.2 Long Term

The DI two-phase implementation shall include a long term capability to address those features that can be implemented when the remainder of the IVHS system is deployed.

2.1.5 Driver Advisory And In-Vehicle Signing

The DI shall include a driver advisory capability and an in-vehicle signing capability (future).

2.2 Driver Advisory

Driver advisory shall be implemented in two phases with first a short term capability and later a long term capability.

2.2.1 Short Term Driver Advisory

The short term DI driver information capability shall include the ability to provide information to travelers within the limited area of deployment.

2.2.1.1 Accurate Information

DI shall include the capability to provide travelers with accurate information concerning available travel options and their state of operational availability.

2.2.1.2 Avoid Congestion

DI shall provide that information to travelers required for them to avoid areas of congestion.

2.2.1.2.1 Plan and Choose Transportation Mode

DI shall provide that information needed from travelers to select those transportation modes that allow them to avoid congestion.

2.2.1.3 Receive Information in Vehicles

DI shall provide the capability for users to receive travel information in their vehicles.

2.2.1.4 Limited Deployment

The short-term DI shall be deployed in those limited areas where the need and associated benefits are more immediate.

2.2.2 Long Term Driver Information

The long term DI capability shall include the ability to provide information to travelers within all geographic areas of the IVHS deployment.

2.3 In-Vehicle Signing

DI shall provide an in-vehicle signing capability.

2.3.1 Short Term In-Vehicle Signing

The DI in-vehicle signing function shall include a short term capability to serve the more immediate needs for travelers.

2.3.1.1 Vision Impaired Individuals

The short term in-vehicle signing function shall include the capability to provide assistance to individuals with impaired vision.

2.3.1.2 Information for Vehicle in Unfamiliar Areas

The short term in-vehicle signing function shall include the capability to provide assistance to individuals needing local guidance in areas that the driver is unfamiliar with (e.g., airports, resort areas).

2.3.1.3 Assistance in Areas with Frequent Poor Visibility

The short term in-vehicle signing function shall include the capability to provide assistance to individuals in areas that frequently have conditions of poor visibility.

2.3.1.4 Augment Existing Signs

The short term in-vehicle signing function shall implemented in a manner that augments existing signs.

2.3.1.4.1 Augment Control Signs (e.g., stop signs)

The short term in-vehicle signing function shall augment control signs (e.g., stop signs).

2.3.1.4.2 Augment Warning Signs

The short term in-vehicle signing function shah augment warning signs (e.g., slow signs).

2.3.1.5 Types Of User Interface

The short term in-vehicle signing function shall provide a user interface that allows travelers to access its capabilities.

2.3.2 Long Term In-Vehicle Signing

The DI in-vehicle signing function shall include a long term capability to serve more of the traveler's needs.

2.3.2.1 Integrated with Other IVHS Capabilities

The long term in-vehicle signing function shall be integrated with other IVHS system capabilities.

2.3.2.2 Custom Warning

The long term in-vehicle signing function shah provide the capability to customize warning.

2.3.2.2.1 Characteristics of Vehicle

The customized warnings function shall provide the capability to control the contents of warning messages to the characteristics of each individual vehicle.

2.3.2.2.2 Environmental Conditions

The customized warnings function shall provide the capability to control the contents of warning messages to the extent of environmental conditions.

2.3.2.3 Roadside Environmental Sensors

The in-vehicle signing function shall provide the capability to utilize data from roadside environmental sensors as inputs to warning messages.

2.3.2.4 Road Conditions

The in-vehicle signing function shall provide travelers with information on road conditions.

2.3.2.5 Precautionary Reminders

The in-vehicle signing function shall provide travelers with precautionary reminder messages.

TRAVELER SERVICE INFORMATION

4.0 Traveler Service Information

IVHS shall include a Traveler Service Information (TSI) function. Traveler Service Information provides travelers with service and facility data for the purpose of assisting prior to embarking on a trip or after the traveler is underway. The functions which are included in this capability are Information Receipt and Information Access. This will provide the traveler with a “yellow pages” type of capability.

4.1 Information Receipt

TSI shall include an Information Receipt function for the collection of that information provided to travelers.

4.1.1 Database

Information Receipt shall provide and maintain a database of local area services available to travelers.

4.1.2 Information Acquired

Information Receipt shall provide the capability to acquire up-to-the-minute information relating to traveler services available in the local area.

4.1.2.1 Traveler Service Conditions

Information Receipt shall acquire information on the condition of local traveler services.

4.1.2.2 Traveler Service Status

Information Receipt shall acquire information on the status of local traveler services.

4.1.2.3 Traveler Service Availability

Information Receipt shall acquire information on the availability of local traveler services.

4.1.2.4 Motorist Services

Information Receipt shall acquire information on the availability of local motorist services.

4.1.2.5 Tourist Services

Information Receipt shall acquire information on the availability of local tourist services.

4.1.3 Pre-Trip Planning Integration

Information Receipt shall be capable of being integrated with Pre-Trip Planning Information.

4.1.4 Support Financial Transactions

Information Receipt shall provide the capability to support those financial transactions required for travelers to be billed for the purchase of activity tickets and room reservations.

4.1.5 Interactive Connectivity

Information Receipt shall include the capability to have interactive connectivity between users, sponsors and providers of services.

4.2 Information Access

TSI shall include an Information Access function that allows travelers to access the available information.

4.2.1 General Information

Information Access shall provide the capability for travelers to request and receive general information about the local area.

4.2.2 Specific Information

Information Access shall provide the capability for travelers to request and receive information about specific services in an area to include, but not be limited to, the following:

- (a) Lodging information
- (b) Food information
- (c) Parking information
- (d) Hours of operation information
- (e) Tourist activities information
- (f) Daily or special events information
- (g) Local hospital information
- (h) Nearest gas station information

4.2.3 Action Request

Information Access shall provide the capability for travelers to request specific actions of areas service providers to include, but not be limited to:

- (a) Lodging reservations
- (b) Dining reservations

4.2.4 Accessibility

Information Access shall provide the capability for all travelers to access information regardless of their particular mode of travel.

4.2.5 Access Method

Information Access shall provide the capability for travelers to access the TSI information via any of, but not limited to, the following methods:

- (a) Highway advisory radio
- (b) Dial-up telephone lines
- (c) Computer at home
- (d) Computer in the office
- (e) In-vehicle computers
- (f) Public area kiosks
- (g) Personal portable devices

4.2.6 Kiosks Location

Information Access shall provide the capability for travelers to access TSI information from public kiosks (a standard free-standing bulletin board that provides real time information to users). Kiosk locations include, but are not limited to:

- (a) Rest areas
- (b) Activity centers
- (c) Tourist attractions
- (d) Service plazas
- (e) Airports

ROUTE GUIDANCE

5.0 Route Guidance

IVHS shall include a Route Guidance (RG) function. Route Guidance will provide travelers with directions to selected destinations. Four functions are provided which are: (1) Provide Directions; (2) Static Mode; (3) Real-Time Mode; and (4) User Interface. The resulting directions given will be based on information about current conditions of transportation systems.

5.1 Provide Directions

RG shall include the capability to provide directions to travelers.

5.1.1 Direct to Selected Location

The Provide Directions function shall issue directions to travelers that is based on information about current conditions of transportation systems.

5.1.2 Current Condition Factors

Current transportation system conditions upon which directions to travelers is based shall include, but not be limited to, the following:

- (a) Current traffic conditions
- (b) Status of transit systems
- (c) Schedules of transit systems
- (d) Events taking place that influence travel routes
- (e) Street closures
- (f) Pedestrian events
- (g) No pedestrian zones

5.1.3 Simple Instructions

The Provide Directions function shall issue traveler directions that are simple and easy to understand in the form of arrow displays or voice messages providing turning instructions of which way to turn onto including, but not limited to, the following:

- (a) Particular streets
- (b) Roads
- (c) Walkways
- (d) Transit facilities

5.2 Static Mode

RG shall include a Static Mode for issuing information to travelers.

5.2.1 Static Mode Information

Static Mode shall provide travelers information including but not limited to, the following:

- (a) Mapping information about roadways
- (b) Scheduling information about transit systems

5.2.2 Static Infrastructure Based Systems

Static Mode infrastructure systems shall provide the capability to have two-way communications between the traveler and the infrastructure.

5.2.2.1 Traveler Directions

The two-way communications shall provide the capability to provide directions back to the traveler that are based on the infrastructure's calculated routing.

5.2.3 Autonomous Mobile Based

The Real-Time Mode shall provide the capability for autonomous operation of mobile based systems.

5.2.3.1 Infrastructure Independent

Autonomous Mobile Based systems shall have the capability to operate independent of infrastructure.

5.3 Real-Time Mode

RG shall include a Real-Time Mode for issuing information to travelers.

5.3.1 Enhanced Performance

The Real-Time Mode shall utilize current travel condition information to provide performance that is enhanced over the Static Mode performance, to include, but not be limited to, the following:

- (a) Traffic condition information
- (b) Dynamic transit schedule information

5.3.2 Two Configurations

The Real-Time Mode shall include the capability to operate in either or both of the following two configurations:

- (a) Route selection processors located on the mobile unit
- (b) Route selection processors installed in the transportation system infrastructure

5.3.2.1 Use Infrastructure Information

Real-Time mobile based systems shall include the capability to receive infrastructure information, when available, and use it in determining routing.

5.3.2.2 Real-Time Infrastructure Based Systems

If current real-time information is included in route determination, the system shall be denoted as an infrastructure-based real-time system.

5.3.3 Real-Time Mobile Based

The real-time mode shall provide the capability for autonomous operation of mobile-based systems.

5.4 User Interface

RG shall include a User Interface function.

5.4.1 User Interface Devices

The User Interface shall provide the capability for travelers to access the system by utilizing interactive devices that include, but are not limited to, the following:

- (a) Visual displays
- (b) Keypads
- (c) Touch sensitive devices
- (d) Computer generated voice
- (e) Voice recognition system

5.4.2 Mobile System Best Information Available

Mobile systems shall use the best information available to provide routing instructions.

5.4.2.1 Customize Routing Selection

Mobile systems shall provide the capability for individual travelers to customize the routing selected for them.

5.4.2.2 Traveler Customizing Inputs

Mobile systems customizing of traveler's routing shall be based on certain conditions specified by the traveler to include, but not be limited to, the following:

- (a) Avoid expressway-type highways
- (b) Avoid multiple mass transit transfers

5.4.3 Infrastructure-Based Route Customizing

Infrastructure-based systems shall also permit individual traveler to customize their routing selection.

5.4.3.1 Demand Prediction

Infrastructure-based systems shall use the traveler's destination information to estimate extra demand on the transportation system and then provide routing to the traveler based on this predicted demand.

RIDE MATCHING AND RESERVATION

6.0 Ride Matching and Reservation

IVHS shall include a Ride Matching and Reservation (RMR) function. Ride Matching Reservation will provide travel users information on travel providers which allows ridesharing opportunities to be expanded. Three major functions are provided which are: (1) Rider Request; (2) Transportation Provider Services; and (3) Information Processing. This will also include a billing service for the providers.

6.1 Rider Request

RMR shall include a Rider Request capability.

6.1.1 Request Methods

Rider Request shall provide the capability for a traveler to request a ride by placing a single request from a facility to include, but not be limited to, the following:

- (a) Telephones (including hearing-impaired capability)
- (b) Kiosks

6.1.2 Traveler Itinerary

Rider Request shall provide a traveler the capability to request a specific itinerary by specifying, but not being limited to, the following:

- (a) Date
- (b) Time of pick-up and drop-off
- (c) Origin
- (d) Destination
- (e) Specific restrictions or preferences

6.1.3 Available Rideshare Options

Based on the traveler's request and specified itinerary, Rider Request shall provide the traveler with the available ridesharing options.

6.1.4 Real-Time Ride matching

Rider Request shall also include the capability to perform real-time ride matching by instantly matching rider and driver.

6.2 Transportation Provider Service

RMR shall include a Transportation Provider Service function.

6.2.1 Provide Billing

Transportation Provider Service shall include the capability for provider to have their billing arranged through a central clearinghouse.

6.2.2 Electronic Safeguards

Transportation Provider Service shall include electronic safeguards against fraud and abuse.

6.2.3 Documentation Generation

Transportation Provider Service shall automatically generate needed reports and financial documentation.

6.2.4 Commercial Providers

Transportation Provider Services shall include the capability for commercial operators such as vanpools and taxis to be included as options for requesting travelers.

6.3 Information Processing

RMR shall include an Information Processing function.

6.3.1 Match Users and Providers

Information Processing shall quickly match preferences and demands of requesting travelers with the service available from providers.

6.3.2 Financial Clearinghouse

Information Processing shall provide a clearinghouse capability for rideshare financial transactions.

6.3.3 Link Travel Modes

Information Processing shall link together services available from all travel modes including, but not limited to, the following:

- (a) Bus
- (b) Rail
- (c) Vanpools
- (d) Express bus
- (e) Commercial providers
- (f) Specialized service
- (g) carpools

6.3.4 Informational Infrastructure

Information Processing shall provide the informational infrastructure needed to connect providers and consumers.

6.3.5 Service Improvement Market Information

Information Processing shall provide the capability to gather that market information needed to assist in the planning of service improvements.

6.3.6 Maintenance Market Information

Information Processing shall provide the capability to gather that market information needed to assist in maintenance of operations.

INCIDENT MANAGEMENT

7.0 Incident Management

IVHS shall include an Incident Management (IM) function. Incident Management will identify incidents and formulate response actions. Six major functions are provided which are: (1) Scheduled Planned Incidents; (2) Identify, Incidents; (3) Formulate Response Actions; (4) Support Coordinated Implementation of Response Actions; (5) Support Initialization of Response to Actions; and (6) Predict Hazardous Conditions.

7.1 Identify Incidents

Incident Management shall provide an incident identification function to identify incidents.

7.1.1 Predicted (Planned) Incidents

The incident identification function shall include the capability to identify predicted incidents.

7.1.1.1 Information Sources

The incident identification function shall use information from the following types of sources, where available, to identify predicted incidents:

- (a) Traffic flow sensors
- (b) Environmental sensors
- (c) Public safety sources
- (d) Media sources
- (e) Weather information sources
- (f) Transportation providers
- (g) Sponsors of special events
- (h) Hazardous condition prediction algorithms

7.1.1.2 Incident Characteristics

The incident identification function shall determine at least the following characteristics of each predicted incident:

- (a) Time
- (b) Extent
- (c) Severity
- (d) Location
- (e) Expected duration

7.1.1.3 Traffic Flow Impact

The incident identification function shall determine the expected traffic flow impact of each predicted incident.

7.1.2 Existing Incidents

The incident identification function shall include the capability to identify existing (both planned and unplanned) incidents.

7.1.2.1 Information Sources

The incident identification function shall use information from the following types of sources, where available, to identify existing incidents:

- (a) Traffic flow sensors
- (b) Environmental sensors
- (c) Public safety sources
- (d) Media sources
- (e) Weather information sources
- (f) Transportation providers
- (g) Travelers

7.1.2.2 Incident Characteristics

The incident identification function shall determine and continuously monitor at least the following characteristics of each existing incident:

- (a) Type
- (b) Extent
- (c) Severity
- (d) Location
- (e) Expected duration

7.1.2.3 Traffic Flow Impact

The incident identification function shall determine and continuously monitor the current and expected traffic flow impact of each existing incident.

7.2 Formulate Response Actions

Incident Management shall provide a response formulation function to formulate appropriate response actions to each identified incident and revise those actions when necessary.

7.2.1 Predicted Incident Scheduling

The response formulation function shall propose and facilitate the appropriate scheduling of those predicted incidents that can be scheduled to minimize incident potential, incident impacts, and/or the resources required for incident management.

7.2.2 Emergency Vehicle Dispatch

The response formulation function shall propose and facilitate the appropriate dispatch of emergency response vehicles to an incident.

7.2.3 Service Vehicle Dispatch

The response formulation function shall propose and facilitate the appropriate dispatch of service vehicles to an incident.

7.2.4 Information Dissemination

The response formulation function shall propose and facilitate the appropriate dissemination of incident related information to travelers and potential travelers.

7.2.5 Traffic Control

The response formulation function shall propose and facilitate the appropriate control of traffic signals and other traffic controls to reduce the traffic flow impact of an incident.

7.3 Support Coordinated Implementation of Response Actions

Incident Management shall include a response implementation function to provide those services needed to implement a coordinated incident response using all appropriate agencies.

7.3.1 Decision Support

The response implementation function shall provide at least the following decision support capabilities needed to implement coordinated incident response actions by all participating institutions:

- (a) Response implementation shall allow coordinated selection/determination of the procedures needed for resolution of each incident and provide the procedures to those agencies responding to the incident.
- (b) Response implementation shall provide the status of all resources needed for incident resolution to those agencies responding to the incident.

7.3.2 Coupling with Other User Services

The response implementation function shall provide a link between Incident Management and all other user services necessary to implement incident response actions,

7.3.3 Response Status

The response implementation function shall provide the capability to disseminate information relating to response status to other agencies and user services.

7.4 Predict Hazardous Conditions

Incident Management shall provide the capability to predict the time and location of hazardous conditions that may cause an incident.

TRAVEL DEMAND MANAGEMENT

8.0 Travel Demand Management

8.1 Management and Control Strategies

Travel Demand Management will generate and communicate management and control strategies that will support and facilitate the implementation of TDM programs, policies and regulations. It consists of two major functions which are: (1) Increase Efficiency of Transportation System; and (2) Provide Wide Variety of Mobility Options.

8.1.1 Communication

TBM shall include a communications function.

8.1.1.1 Send To Remote Locations

The communication function shall include the capability to send the information needed to implement management and control strategies that are in response to policies and regulations.

8.1.1.2 Communication Locations

The communication function shall include the capability to send information and rates needed to implement management and control strategies that respond to changing environments, conditions, and policy needs to include, but not be limited to, the following locations of action:

- (a) Parking facilities
- (b) HOV lanes
- (c) Transit centers
- (d) Employment sites
- (e) Toll facilities
- (f) Travel (and traveler) information facilities
- (g) Ridesharing facilities

8.1.1.3 Receive Information and Rates

TDM shall provide the capability to receive information and rates needed to implement management and control strategies that respond to changing environments, conditions, and policy needs to include, but not be limited to, the following locations of action:

- (a) Parking facilities
- (b) HOV lanes
- (c) Transit centers
- (d) Employment sites

- (e) Toll facilities
- (f) Travel (and traveler) information facilities
- (g) Ridesharing facilities

8.1.1.4 Send Information and Data

The communications function shall provide the capability to send information and data needed to implement management and control strategies that respond to changing environments, conditions, and policy needs including, but not limited to, the following:

- (a) Sensor data
- (b) Individual vehicle monitoring
- (c) Parking availability
- (d) Usage data

8.1.1.5 Receive Information

The communications function shall provide the capability to receive information and data from transportation operators and/or users that delineates their:

- (a) Current status
- (b) Needs
- (c) Level of activity

8.1.1.6 Communications With Other IVEIS Services

The communications function shall include the capability for two-way communications with other IVHS user services including, but not limited to, the following:

- (a) Pre-trip planning
- (b) Enroute transit advisory
- (c) Driver information
- (d) Ride matching and reservation
- (e) Electronic payment
- (f) Traffic control

8.1.2 Processing

TDM shall include a processing function.

8.1.2.1 Generate Management and Control Strategies

The processing function shall provide the capability to generate management and control strategies that facilitate the implementation of policies and regulations to address the following:

- (a) Vehicle trip reduction
- (b) HOV lanes and ramps

- (c) Parking management and control
- (d) Ridesharing and transit
- (e) Air pollution/emission information and detection
- (f) Public awareness of travel alternatives

8.1.2.2 Enhance and Enforce Policies

The processing function shall provide those capabilities needed to enhance the ability to implement and enforce the following:

- (a) Federal policies
- (b) State policies
- (c) Local policies

8.1.2.3 Guide Operation of Physical Systems

Strategies developed by the processing function shall include the guidance for the operation of physical systems that:

- (a) Monitor traffic
- (b) Inform travelers
- (c) Collect fees
- (d) Detect traffic

8.1.2.4 Generate Pricing and Controls

The processing shall provide the capability generate guidance for the pricing and control for locations of action that include, but are not limited to, the following:

- (a) Parking facilities
- (b) HOV lanes
- (c) Transit centers
- (d) Employment sites
- (e) Toll facilities
- (f) Travel information facilities
- (g) Ridesharing facilities

8.1.2.5 Accommodate Issues

The processing function shall provide the capability to develop strategies for implementation of policies and regulations that will accommodate the following:

- (a) Public sector users and service providers
- (b) Private sector users and service providers
- (c) Issues of legality

- (d) Privacy act
- (e) Multi-jurisdictional settings

8.1.2.6 Dynamic Control and Strategies

The processing function shall provide the capability to generate management and control strategies that dynamically respond to changing environments, conditions, and policies.

8.1.2.7 Control HOV Facilities

The processing function's dynamically generated management and control strategies shall include the control of HOV facilities including, but not limited to, the following:

- (a) Lanes
- (b) Ramps
- (c) Parking areas

8.1.2.8 HOV Control Factors

The processing function's generation of management and control strategies for HOV facilities shall include as factors, but not be limited to, the following:

- (a) Auto occupancy requirements
- (b) Priority for selected vehicle types at ramps
- (c) Priority for selected vehicle types at signalized intersections

8.1.2.9 Congestion Control

The processing function's dynamically generated management and control strategies shall include those roadway pricings that respond to the need for congestion control to include, but not be limited to, the following:

- (a) Road user and toll rates
- (b) Transit fares adjusted concomitant with tolls
- (c) Time of day usage pricing (i.e. off hour rates)

8.1.2.10 Parking Management

The processing function's dynamically generated management and control strategies shall include the parking management and controls to include, but not be limited to, the following:

- (a) Price structure
- (b) Allocation to selected vehicles
- (c) Variable message signs

8.1.2.11 Parking Management Factors

The processing function's dynamically generated management and control strategies for parking management and controls shall be based on factors including, but not limited to, the following:

- (a) Parking availability
- (b) Usage data

8.1.2.12 Control of Pollution

The processing function's dynamically generated management and control strategies shall include the capability to respond to the need for control of pollution by generating messages for variable signs that include, but are not limited to, the following:

- (a) Informing of higher tolls
- (b) Informing of higher parking fees

8.1.2.13 Pollution Control Factors

The processing function's dynamically generated management and control strategies for air pollution control shall be based on factors that include, but are not limited to, the following:

- (a) Sensor data
- (b) Individual vehicle monitoring
- (c) Individual vehicle database files

8.1.2.14 Mode Change Support

The processing function's dynamically generated management and control strategies shall include the capability to respond to the need for the traveler to change modes by generating messages for variable signs that include, but are not limited to, the following:

- (a) Where the mode change requests are being made.
- (b) How the mode changes are requested to be made.
- (c) Why the mode changes are requested to be made.

8.2 Remote Facilities Information Sources/Control

TDM shall include a sensors/control function.

8.2.1 Gather Information

The sensors/control function shall provide the capability to gather information needed for the generation of management and control strategies including, but not limited to, the following:

- (a) Parking availability
- (b) Usage levels

(c) Vehicle occupancy

(d) Vehicle pollution levels.

TRAFFIC CONTROL

9.0 Traffic Control

IVHS shall provide a Traffic Control capability. Traffic Control provides the capability to efficiently manage the movement of traffic on streets and highways. Four functions are provided which are: (1) Traffic Flow Optimization; (2) Traffic Surveillance; (3) Control Function; and (4) Provide Information. This will also include control of network signal systems with eventual integration of freeway control.

9.1 Traffic Flow Optimization

Traffic Control shall include a Flow Optimize function to provide the capability to optimize traffic flow.

9.1.1 Traffic Movement Efficiency

The Flow Optimize function shall employ control strategies that seek to maximize traffic-movement efficiency.

9.1.1.1 Traffic On Streets

Traffic-movement control shall manage movement of traffic on streets.

9.1.1.2 Traffic On Highways

Traffic-movement control shall manage movement of traffic on highways.

9.1.1.3 Minimize Delay

Traffic-movement control shall include the goal of minimizing delay times,

9.1.1.4 Minimize Energy Use

Traffic-movement control shall include the goal of minimizing energy use.

9.1.1.5 Minimize Air Quality Impacts

Traffic-movement control shall include the goal of minimizing air quality impacts due to traffic.

9.1.2 Area Wide Optimization

The Flow Optimize function shall include a Wide Area optimization capability, to include several jurisdictions.

9.1.2.1 Integrated Freeways and Network Signal Controls

Wide area optimization shall integrate the control of network signal systems with the control of freeways.

9.1.2.2 Transit Preferential Treatment

Wide area optimization shall include features that provide preferential treatment for transit vehicles.

9.1.2.3 HOV Preferential Treatment

Wide area optimization shall include features that provide preferential treatment for HOV.

9.1.3 Optimize Over Large Geographic Area

Flow optimize shall be implemented in a manner that seeks to optimize traffic movement over a large geographic area.

9.1.4 Current and Expected Demand

Flow optimize shall include a Control function that is responsive to both the current demand as well as the expected demand.

9.1.4.1 Facilitate Dissipation Congestion

Traffic control shall include the capability to facilitate the dissipation of traffic congestion.

9.1.5 Predict Travel Patterns

Flow Optimize shall provide the capability to predict travel patterns.

9.1.6 Feedback On Control Strategies

The Control Function shall include the use of data acquired from traffic surveillance as feedback to the control strategies.

9.1.7 Implemented to Include User

Implementation of the Control Function shall include strategies that account for at least the following:

- (a) Human factors
- (b) Driver/traveler behavior and expectancies

9.2 Traffic Surveillance

Traffic Control shall include a Traffic Surveillance function.

9.2.1 Detection of Vehicles

Traffic Surveillance shall include a Vehicle Detection function with the capability of accurately detecting vehicles in a real-time fashion.

9.2.1.1 Knowledge of HOV

Vehicle Detection shall include the capability of determining those vehicles that are HOVs.

6.3.4 Informational Infrastructure

Information Processing shall provide the informational infrastructure needed to connect providers and consumers.

6.3.5 Service Improvement Market Information

Information Processing shall provide the capability to gather that market information needed to assist in the planning of service improvements.

6.3.6 Maintenance Market Information

Information Processing shall provide the capability to gather that market information needed to assist in maintenance of operations.

9.3.2 Area Wide Control

The real-time traffic-adaptive control portion of the Control Function shall be an area wide control to include several jurisdictions.

9.3.2.1 Avoid Conflicting Control

The area wide control shall be implemented in an integrated and consistent manner that avoids the issuance of conflicting controls.

9.3.2.2 Vehicle Priority

The area wide control shall be implemented in a manner that permits the following types of vehicles to have preference over other vehicles being controlled.

- (a) Transit
- (b) HOV
- (c) Emergency Medical Service Vehicles

9.3.3 Device Types

The Device Control function shall provide the capability to exercise control over those devices utilized for traffic control.

9.3.3.1 Signalization

Device Control shall include the capability to control traffic signalization, including rapid modification of signalization parameters to respond to traffic requirements.

9.3.3.2 Signing

Device Control shall include the capability to control dynamically traffic signing.

9.3.3.3 Freeway Ramp Metering

Device Control shall communicate control data to the following devices.

- (a) Traffic signals
- (b) Ramp meters
- (c) Information signs
- (d) HOV lanes
- (e) Human operator support

9.3.4 Process Traffic Data

Traffic Surveillance shall include a Data Process function to process the traffic data acquired.

9.3.5 Override By Operator

Device Control shall provide the operator with the capability to manually override the system's automatic controls.

9.3.6 Coordination with Other TMC's

Device Control shall provide the operator the capability to adaptively change system response in order to provide a coordinated support of other TMCs that are responding to incidents.

9.4. Provide Information

The Control Function shall provide traffic control information to other elements of the IVHS, including, but not limited to, the following:

- (a) In-vehicle navigation
- (b) Trip planning
- (c) Routing systems
- (d) Fleet management systems

COMMERCIAL FLEET MANAGEMENT

15.0 Commercial Fleet Management

IVHS shall include a Commercial Fleet Management (CFM) function.

15.1 Provide Real-Time Information

CFM shall include the capability for users to provide commercial drivers and dispatchers with real-time routing information in response to congestion or incidents.

15.2 Real-Time Communication

CFM shall provide the capability for real-time communication between the following:

- (a) Vehicle drivers
- (b) Dispatchers
- (c) Intermodal transportation providers

PUBLIC TRANSPORTATION MANAGEMENT

16.0 Public Transportation Management

IVHS shall include a Public Transportation Management (PTM) function.

16.1 Operations

PTM shall include an Operation of Vehicles and Facilities (OVF) function that provides computer assisted control of the operation of vehicles and their associated facilities.

16.1.1 Data Generation

To enable the automation of the vehicle and facilities operations, OVF shall provide the capability to gather the needed data to include, but not be limited to, the following:

- (a) Vehicle passenger loading by bus stop and trip segment
- (b) Bus running times between time points
- (c) Fare collection by fare category
- (d) Drive-line operating condition
- (e) Mileage accumulated by individual buses
- (f) Real-time vehicle location reports

16.1.2 Command and Control

OVF shall include a Command and Control (CC) capability.

16.1.2.1 Command and Control of Vehicles

CC shall provide the capability for real-time Vehicle Command and Control (VCC).

16.1.2.1.1 Determine Deviations

VCC shall provide the capability to compare received information with predetermined operating condition specifications and note any deviations.

16.1.2.1.2 Transmit Deviations

VCC shall provide the capability to transmit noted deviations to central control.

16.1.2.1.3 Display Deviations

VCC shall provide the capability to display any noted deviations.

16.1.2.1.4 Corrective Instructions

VCC shall provide the capability to automatically issue corrective instructions to the driver including, but not limited to, the following:

- (a) Route corrections
- (b) Changes in stops

16.1.2.2 Operational Adjustments

When CC detects a vehicle(s) has deviated from the schedule, it shall provide the capability to automatically determine the optimum scenario for returning the vehicle or fleet to schedule.

16.1.2.3 Integrated Traffic Control

CC shall include the capability for its computational capabilities to be located either on-vehicle and/or at remote locations.

16.2 Planning and Scheduling Services

PTM shall include a Planning and Scheduling Services (PSS) function to automate the planning and scheduling of public transit operations.

16.2.1 Planning

The PSS shall include a planning capability.

16.2.1.1 Off-Line Operation

PSS Planning shall be performed off-line from stored data collected in real-time.

16.2.1.2 Route and Service Improvement

PSS planning shall include processing of the data in a manner that will permit improvements in routes and services.

16.2.2 Schedule Generation

The PSS shall include a Schedule Generation capability.

16.2.2.1 Data Collection

The PSS Schedule Generation function shall collect that data needed for schedule generation including, but not limited to, the following:

- (a) Route segment running-time
- (b) Passenger loading at each stop
- (c) Revenue information

16.2.2.2 Generate Schedules

The PSS Schedule Generation function shall use the collected data in the automatic or semi-automatic development of transportation system schedules.

16.2.2.3 Print Schedules

The PSS Schedule Generation function shall provide the capability to print schedules.

16.2.2.4 Disseminate Schedules

The PSS Schedule Generation function shall provide the capability to disseminate schedules to, but not be limited to, the following:

- (a) Kiosks
- (b) Transportation Management Center

16.2.2.5 Update Customer Service System

The PSS Schedule Generation function shall provide the capability to automatically update the customer service operator system with the most current schedule and schedule adherence information.

16.3 Personnel Management

PTM shall include a Personnel Management (PM) function to facilitate the management of both driver and maintenance personnel.

16.3.1 Maintenance Personnel Management

PM shall include a Maintenance Personnel Management (MPM) function.

16.3.1.1 Track Bus Mileage

MPM shall automatically track vehicle miles on each bus in real-time.

16.3.1.2 Generate Maintenance Schedules

MPM shall use bus mileage data to automatically generate preventative maintenance schedules for each specific bus.

16.3.1.3 Ensure Proper Service Personnel

MPM shall automatically ensure that proper service personnel are provided information for bus maintenance activities.

16.3.1.4 Assign Technicians

MPM shall automatically assign service technicians by skill level to work on individual buses.

16.3.1.5 Record and Verify

MPM shall provide the capability to record and verify that maintenance work was performed.

16.3.2 Driver Personnel Management

PM shall include a Driver Personnel Management (DPM) function.

16.3.2.1 Driver Assignment

DPM shall automatically generate assignments of individual drivers to route, runs and individual vehicles.

16.3.2.2 Minimize Costs

DPM shall assign drivers to routes and runs in a fair manner while minimizing labor and overtime costs.

16.3.2.3 Driver Assignment Factors

In generating fair driver assignments, DPM shall include factors relating to driver preferences and qualifications to include, but not be limited to, the following:

- (a) Seniority
- (b) Driver schedule preference
- (c) Garage assignment
- (d) Vehicle qualification

16.3.2.4 Validate Driver Work Hours

DPM shall automatically track and validate the number of work hours performed by each individual driver.

16.4 Communications

PTM shall include a communications function.

16.4.1 Voice Communications

PTM communications shall provide the capability to establish two-way voice communication between in-vehicle drivers and the central facility.

16.4.2 Data Communications

PTM communications shall provide the capability for two-way data communications between individual buses and the control facility (e.g., sensor data and bus position).

16.4.3 Facilities Data

OVF communications shall provide the capability to send information from individual facilities to a central facility for processing and analysis.

16.4.4 Emergency Assistance

As support for responding to the detection of an on-board emergency the OVF communications shall provide dispatchers with the capability to inform the following:

- (a) Police
- (b) Fire department

(c) Paramedic

(d) Driver (initiation of silent alarm notification)

16.4.5 Open Communications Standard

PTM shall use an open vehicle communication network standard for all on-board electronic equipment.

Source: IVHS User Service Requirements, USDOT, FHWA, October, 1993